

REMARKS

Each rejection raised by the Examiner is addressed separately below. In view of the claim amendments noted above and the remarks below, Applicants respectfully request reconsideration of the merits of this patent application.

IN THE CLAIMS

Claims 2, 4-6, 8 and 12-15 have been amended herein. Claims 1, 3, 7, 9-11 and 16-28 have been cancelled. Claims 29-31 are new. Support for the amendments can be found in the specification as filed. No new matter has been added.

§102 REJECTIONS

Claims 1-28 have been rejected as being anticipated by U.S. Patent No. 6,207,392 to Weiss et al. (Weiss). Specifically, the Examiner alleges that Weiss discloses a composite nano-particle as claimed. Applicants submit that the rejection of claims 1-28 has been overcome by the appropriate amendments to the claims.

Specifically, our review of Weiss shows that Weiss discloses nano-crystal probes for biological applications wherein the probes include a plurality of semiconductor nano-crystals capable of providing a detectable signal in response to exposure to energy. The semiconductor nano-crystals used in Weiss include nano-crystals of Group II-VI semiconductors such as MgS, MgSe, MgTe, CaS, CaSe, CaTe, SrS, SrSe, SrTe, BaS, BaSe, BaTe, ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe and HgTe as well as nano-crystals of Group III-V semiconductors such as GaAs, InGaAs, InP and InAs (see Weiss, column 7, lines 37-41).

However, Weiss does not teach or disclose use of the nano-crystal phosphor particle comprising the sulfide phosphor host material doped with the activator set forth in the amended claims of the application. Accordingly, Applicants respectfully submit that the amendments clearly define the present invention over Weiss, and the rejection to the claims as now amended should be withdrawn.

Specifically, the claims have been amended herein to recite an electron-excited nano-crystal phosphor prepared from a nano-phosphor particle selected from the group consisting of ZnS:Mn, ZnS:Cl, ZnS:Cu, Al, CaS:Eu, CaS:Ce, CaS:Mn, CaS:Cu, CaS:Sb, CaS:Eu, Ce, CaS:Sm, CaS:Pb, CaS:Gd, CaS:Tb, CaS:Dy, CaS:Ho, CaS:Er, CaS:Tm, CaS:Yb, MgS:Eu, MgS:Ce, MgS:Mn, SrS:Eu, SrS:Ce, SrS:Mn, BaS:Eu, BaS:Ce and BaS:Mn (see new claim 29). Support for new claim 29 can be found in the application as filed at page 7. The phosphor according to the present invention comprises sulfide phosphor host material doped with an activator. In the doped nano-crystal phosphor particle of the present invention, such as, for example, ZnS:Mn²⁺, upon excitation or irradiation of the particles with an energy gap larger than the energy gap of the host material (i.e. ZnS), electrons and holes are generated in the conduction and the valence bands,

respectively. Meanwhile, defects are also created. For instance, electrons may be trapped at the defects to form color centers, and holes may be combined with Mn^{2+} to form Mn^{3+} . When the nano-particles are stimulated with light corresponding to the absorption band of the color centers, the electrons will be detrapped from the defects and recombined with Mn^{3+} to yield the appropriate luminescence of Mn^{2+} . Accordingly, Applicants respectfully submit that the amendments clearly define the present invention over Weiss, and the rejection to the claims as now amended should be withdrawn.

In the method of preparing an electron-excited nano-crystal phosphor of the present invention, the nano-crystal phosphor is prepared by a sequential step of adding the sulfide phosphor host material as an anion and Group II metal as a cation so as to co-precipitate the anion material and the cation material in that order in the presence of a dispersion-stabilizing agent and a surface modifying agent so that a nano-crystal phosphor having good dispersibility and little aggregation can be obtained (see new claim 30). Support for new claim 30 can be found in the application as filed at page 19. new claim 31 recites that the dispersion-stabilizing agent is sodium citrate, and support for this can be found in the application as filed at page 20. Weiss does not teach or suggest a method of preparing an electron-excited nano-crystal comprising adding sulfide phosphor matrix and then adding a Group II metal as a cation material (in that order) so as to co-precipitate the anion material and the cation material in that order as set forth in the amended claims. Accordingly, Applicants respectfully submit that the amendments clearly define the present invention over Weiss, and the rejection to the claims as now amended should be withdrawn.

Pertaining to claim 1, the Examiner alleges that Weiss teaches a composite nano-particle comprising a core part of a nano-crystal, a surface-modifying part having a bonding part for bonding the periphery of said core part to the nano-crystal and a substance having an insulating shell part having as a substrate a substance forming a glass state, characterized in that the surface of the periphery of said core part is coated with the surface modifying part having the bonding part for bonding to a bond defect of said nano-crystal and the substance having the insulating shell part having as the substrate the substance forming a glass state (see column 10, lines 30-40). By cancelling claim 1, and without agreeing to the Examiner's characterization of Weiss, Applicants submit the rejection of claim 1 has been rendered moot.

Pertaining to claim 2, the Examiner alleges that Weiss teaches a composite nano-particle composed of three parts comprising a core part of a nano-crystal, a surface-modifying part for coating the surface of said core part to modify the surface, and an insulating shell part the peripheral surface of which is charged by the same charge made up of a substance forming a glass state so as to coat the surface of said surface-modifying part. As amended, claim 2 now depends from new claim 29. As discussed above, Weiss does not teach use of the nano-crystal phosphor particle comprising the sulfide phosphor host material doped with the activator as recited in the claims as amended.

Pertaining to claim 3, the Examiner alleges that Weiss teaches a composite nano-particle composed of three parts of a nano-sized composite nano-particle comprising a core part of a nano-crystal, a surface-modifying part for coating the surface of said core part to modify the surface, and an insulating shell part so formed as to coat the surface of said surface-modifying part, characterized in that said core part and said surface-modifying part are formed simultaneously by a co-precipitation method in the presence of both a dispersion stabilizing agent and a surface-modifying agent. By cancelling claim 3, and without agreeing to the Examiner's characterization of Weiss, Applicants submit the rejection of claim 3 has been rendered moot.

Pertaining to claim 4, the Examiner alleges that Weiss teaches a composite nano-particle wherein the surface-modifying agent is an organometallic compound having SH group, $-NH_3$ group at its terminal and that the insulating shell part comprises a transparent material. Pertaining to claim 5, the Examiner alleges that Weiss teaches a composite nano-particle wherein the transparent material comprises SiO , SiO_2 , SiN , $SiON$, Si_3N_4 , Al_2O_3 , and TiO_2 . Pertaining to claim 6, the Examiner alleges that Weiss teaches a composite nano-particle wherein said dispersion-stabilizing agent is sodium citrate and said surface-modifying agent is illustrated by the general formula; $(R1O)(R2O)(R3O)Si-R4-SH$ wherein each of $R1$, $R2$, $R3$ and $R4$ is an alkyl group. As claims 4-6 have all been amended to depend from new claim 29, which, as discussed above, is not anticipated by Weiss, Applicant's submit the rejection of claims 4-6 has been overcome.

Pertaining to claim 7, the Examiner alleges that Weiss teaches a composite nano-particle wherein said nano-crystal is a phosphor particle selected from the group consisting of $ZnS:Mn$, $ZnS:Cl$, $ZnS:Cu$, Al , $ZnCd:Ag$, Cl , $CaS:Eu$, $CaS:Ce$, $CaS:Mn$, $CaS:Cu$, $CaS:Sb$, $CaS:Eu$, Ce , $CaS:Sm$, $CaS:Pb$, $CaS:Gd$, $CaS:Tb$, $CaS:Dy$, $CaS:Ho$, $CaS:Er$, $CaS:Tm$, $CaS:Yb$, $MgS:Eu$, $MgS:Ce$, $MgS:Mn$, $SrS:Eu$, $SrS:Ce$, $SrS:Mn$, $BaS:Eu$, $BaS:Ce$ and $BaS:Mn$ (see column 7, lines 37-39). However, by cancelling claim 7, and without agreeing to the examiner's characterization of Weiss, Applicants submit the rejection of claim 7 has been rendered moot.

Pertaining to claim 8, the Examiner alleges that Weiss teaches a composite nano-particle wherein the surface-modifying layer of the composite nano-particle is carbonized. Claim 8, as amended, also depends from claim 29, and accordingly, Applicants submit that claim 8 cannot be anticipated by Weiss.

Pertaining to claims 9-11, the Examiner alleges that Weiss teaches a method of preparing a composite nano-particle comprising the steps of: forming, at the same time, a core part of a nano-sized phosphor particle and a surface-modifying part for coating the surface of said core to modify the surface of said core by a co-precipitation method in the presence of a vitrification-inhibitor for an insulating part comprising as a substrate a substance for forming a glass state in the presence of both a dispersion stabilizing agent and a surface-modifying agent; and forming a nano-sized insulating part on the surface of said surface-modifying part; wherein the step of forming the composite nano-particle comprises a step of adding as a material for co-precipitating the phosphor an anion material and a cation material, in that order. By cancelling claims 9-11,

and without agreeing to the Examiner's characterization of Weiss, Applicants submit the rejection of claims 9-11 has been rendered moot.

Pertaining to claim 12, the Examiner alleges that Weiss teaches a method of preparing a composite nano-particle wherein said dispersion-stabilizing agent is a metallic salt having two carboxyl groups or above. Pertaining to claim 13, the Examiner alleges that Weiss teaches a method of preparing a composite nano-particle wherein said surface-modifying agent is an organometallic compound having -SH group, -NH₃ group at its terminal. Pertaining to claim 14, the Examiner alleges that Weiss teaches a method of preparing a particle using 3-mercaptopropyl trimethoxysilane. Pertaining to claim 15, the Examiner alleges that Weiss teaches a method of preparing a composite nano-particle wherein the insulating shell layer is formed of sodium silicate. As amended, all of claims 12-15 now depend from new claim 30. As discussed above, new claim 30 is not anticipated by Weiss, as Weiss does not teach or suggest a method of preparing an electron-excited nanocrystal comprising adding sulfide phosphor matrix and then adding a Group II metal as a cation material (in that order) as set forth in the amended claims. Accordingly, Applicants respectfully submit that claims 12-15 are not anticipated by Weiss.

Pertaining to claims 16-28, Applicants submit by cancelling claims 16-28, and without agreeing to the Examiner's characterization of Weiss, Applicants submit the rejection of claims 16-28 has been rendered moot..

Accordingly, Applicants submit the rejection of claims 1-28 as anticipated by Weiss has been overcome and should be withdrawn.

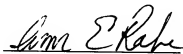
SUMMARY

Having addressed each issue raised by the Examiner, pending claims 2, 4-6, 8, 12-15 and 29-31 as amended are believed to be in condition for allowance and a Notice of Allowance is respectfully requested. Should any issues remain outstanding, the Examiner is invited to contact the undersigned at the telephone number appearing below if such would advance the prosecution of this application.

A Petition for Three-Month Extension of Time is included herewith. However, if any additional extension of time is required in this or any subsequent response, please consider this to be a petition for the appropriate extension and a request to charge the petition fee to Deposit Account No. 17-0055. No other fee is believed to be due in connection with this response. However, if any fee is due in this or any subsequent response, please charge the fee to the same Deposit Account No. 17-0055.

Respectfully submitted,

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